

## A new synopsis of the scorpion fauna of the Manaus region in Brazilian Amazonia, with special reference to an inundation forest at the Tarumã Mirim river

by

W.R. Lourenço, J. Adis & J. de S. Araújo

Dr. Wilson R. Lourenço, Département de Systématique et Evolution, USM 0602, Section Arthropodes (Arachnologie), Muséum national d'Histoire naturelle, CP 053, 61 rue Buffon 75005 Paris, France; e-mail: arachne@mnhn.fr

Prof. Dr. Joachim Adis, Tropical Ecology Working Group, Max-Planck-Institute for Limnology, Postfach 165, D-24302, Ploen, Germany; e-mail: adis@mpil-ploen.mpg.de

B.Sc. Juliana de Souza Araújo, Instituto de Pesquisas da Amazônia (INPA), Coordenação de Pesquisas em Entomologia (CPEN), Caixa Postal 478, 69011-970, Manaus/-AM, Brazil; e-mail: juliana.araujo@pop.com.br

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### Abstract

A new species of Buthidae, *Tityus lokiae*, is described from a blackwater inundation forest at the Tarumã Mirim river near Manaus, Amazonas State, Brazil. This is the second member to join the '*Tityus adisi*' group of species. So far, 14 scorpion species are known from the region of Manaus. First ecological aspects are given for all six species occurring in the inundation forest.

Keywords: Scorpiones, Buthidae, *Tityus*, new species, Igapó, Tarumã Mirim, Manaus, Amazon, Brazil.

### Resumo

Uma nova espécie de Buthidae, *Tityus lokiae*, é descrita de uma floresta inundável de água preta do Rio Tarumã Mirim, próxima a Manaus, Estado do Amazonas, Brasil. Este é o segundo membro a ser incluído no grupo de espécies "*Tityus adisi*". Até o momento 14 espécies de escorpião são conhecidas para a região de Manaus. Primeiros aspectos ecológicos são fornecidos para todas as seis espécies que ocorrem na floresta inundável.

### Introduction

As emphasized by LOURENÇO (2002a, b), the inventory of the scorpions of Brazilian Amazonia has greatly increased during the recent years. A preliminary synthesis made by LOURENÇO (1986) was followed by a much more detailed one (LOURENÇO 2002b), in which all known Amazonian scorpions were listed. The region of Manaus in the State of Amazonas, Brazil, is undoubtedly the best studied within the Amazonian region (LOURENÇO 2002b). This is due to intensive collecting by the senior author during several field trips undertaken over the last twenty years, to important long-term monitoring of the second author (cf. ADIS 1981; ADIS 2002), as well as to contribu-

tions from other colleagues working in the area. Shortly after the second synthesis had been proposed by LOURENÇO (2002b), several new species were discovered and described (LOURENÇO & PÉZIER 2002; LOURENÇO & SOUZA ARAÚJO 2004; MONOD & LOURENÇO 2001; PINTO-DA-ROCHA et al. 2002). So it is evident that the inventory is still far from complete.

All the 14 species of scorpion so far discovered and described (Table 1) have been found on or near non-flooded uplands (terra firme), inundation forests (igapó, igapó & várzea; cf. ADIS 2002), or both. In this paper, a new buthid species, *Tityus lokiae*, is described from a blackwater inundation forest at Tarumã Mirim river (Fig. 8). This is the second species to be placed in the '*Tityus adisi*' group, as defined by LOURENÇO & PÉZIER (2002). First ecological observations are presented for all six species occurring in the inundation forest.

### Systematics

#### Key to the group of species of *Tityus* confirmed to the Manaus region

1. Small species ranging from 18 to 40 mm in total length with variegated pigmentation . . . . . 2
- (1) Medium or large species, ranging from 50 to 100 mm in total length; pigmentation varying from yellowish to brown and black . . . . . 3
2. With a highly rhomboidal subaculear tooth . . . . . *Tityus clathratus* group
- (2) With a spinoid subaculear tooth . . . . . *Tityus adisi* group
3. Species of medium size, ranging from 50 to 70 mm in total length; coloration rather pale, varying from yellowish to reddish-brown or brownish, never black; often with conspicuous dark spots; basal middle lamellae of female pectines not dilated in most species . . . . . *Tityus bahiensis* group
- (3) Large species, ranging from 65 to 100 mm in total length; pigmentation blackish in the adult and yellowish/variegated in immature individuals; subaculear tooth always spinoid; basal middle lamellae of female pectines dilated in most species . . . . . *Tityus asthenes* group

#### *Tityus lokiae* n.sp. (Figs. 1-7)

Brazil, Amazonas State, Rio Tarumã Mirim (Igapó; Fig. 8), blackwater inundation forest (L. SCHMIDT & J. ADIS), 1-IV-1985, 1 female holotype, 10 juvenile paratypes.

Deposited in the Instituto de Pesquisas da Amazônia (INPA), Manaus, Brazil. Three paratypes (juveniles) in the Muséum national d'Histoire naturelle, Paris, France.

Etymology : Patronym in honor of Prof. Dr. Loki SCHMIDT, Hamburg, Germany, to acknowledge her thirst for knowledge of biological research in Central Amazonia.

Diagnosis: Small scorpions, measuring 27 mm in total length. Coloration yellowish to reddish-yellow with variegated brown spots over the body and appendages. Granulation weak and thin over all the body and pedipalps. Fixed and movable fingers of pedipalps with 12/13 rows of granules. All carinae complete or almost complete. Pectines small with minute fulcra. Pectinal tooth count 16-16 (variation in females, 15-17). Basal middle lamella dilated, triangular in shape. Telson rounded with a spinoid subaculear tubercle.

All the groups of *Tityus* as defined by LOURENÇO (2002a) can be found in the Manaus region. The new species is accommodated in the '*Tityus adisi*' group, designated by LOURENÇO & PÉZIER (2002) for the species *Tityus adisi*, recognized mainly by its yellow-variegated pigmentation and the structure of the telson and subaculear tubercle. *Tityus lokiae* n.sp. can, however, be distinguished from *T. adisi* by the following characters:

- The variegated pattern of pigmentation is different. *Tityus lokiae* n.sp., is paler yellow, with less marked spots on the metasoma.
- Subaculear tubercle very strong and spinoid in the new species, whereas in *T. adisi* it is also spinoid but moderate.
- Fulcra are vestigial in *Tityus lokiae* n.sp.

### Description based on female holotype. Morphometric values in Table 2

Coloration. Generally yellowish to reddish-yellow, symmetrically marbled with dark reddish-brown producing an overall variegated appearance. Prosoma: carapace yellowish with variegated spots more heavily marked at the anterior margin; eyes surrounded by black pigment. Mesosoma: yellowish with variegated brown spots over the tergites, clustered into three longitudinal stripes. Metasoma: segments I-III yellowish with variegated diffused brown spots over all surfaces; segment IV slightly darker, reddish-yellow; segment V reddish; dark spots more intensively marked on segments IV-V. Vesicle reddish like segment V; aculeus reddish-yellow. Venter yellowish without spots. Chelicerae yellowish with dark variegated spots; base of fingers yellowish; fingers yellowish with a few brown spots; teeth pale reddish. Pedipalps: yellowish with several brown spots on the femur, patella and chela; fingers yellowish but more densely spotted than the hand of the chela; rows of granules on dentate margins of the fingers, pale reddish. Legs yellowish with diffused brown variegated spots on all segments.

Morphology. Prosoma: Anterior margin of carapace only moderately emarginate. Carapace carinae weakly developed; anterior median carinae moderate; central median and posterior median carinae weak; central lateral carinae vestigial. All furrows weak. Intercarinal spaces weakly granular, except for the anterior margins, which are moderately granular. Median ocular tubercle anterior to the centre of the carapace; median eyes separated by slightly more than one ocular diameter. Three pairs of lateral eyes. Mesosoma: Tergites I-VI with one weakly marked median carina. Tergite VII pentacarinata, lateral pairs of carinae weak; median carinae, in proximal third, moderate to weak. Intercarinal spaces weakly granular. Sternites: carinae absent on III-VII; spiracles slit-like but short. Pectines small with minute fulcra; basal middle lamella dilated, triangular in shape; pectinal tooth count 16-16. Metasoma: Segments I-II with 10 carinae; III-IV with 8 carinae; segment V with 5 carinae. Dorsal furrows of all segments weakly developed; intercarinal spaces weakly granular on segments I to III, moderately granular on IV-V. Telson with a moderate ventral carina, and with some strong granules on ventral and lateral faces. Aculeus moderately long, strongly curved; subaculear tubercle very strong and spinoid. Chelicerae with two much reduced and almost fused denticles at the base of the movable finger in ventral aspect (VACHON 1963). Pedipalps: Femur pentacarinata; all carinae moderately crenulate. Patella with 7 carinae; internal carina with spinoid granules; chelae with 7/8 vestigial carinae; all faces weakly granular. Dentate margins of fixed and movable fingers composed of 12/13 oblique rows of granules. Trichobothrial pattern orthobothriotaxic, type A (VACHON 1974); dorsal trichobothria of femur in  $\alpha$  (alpha) configuration (VACHON 1975). Legs: Ventral aspect of tarsi with numerous thin setae. Tibial spurs absent. Pedal spurs present on all legs; vestigial on I-II and moderate on III-IV.

### Ecological aspects

Despite intensive collecting efforts (cf. ADIS 1981; ADIS 1997; ADIS 2002), only 31 scorpions were taken by the second author and his collaborators in 1975-1987 from the blackwater inundation forest (igapó) at Tarumã Mirim river. However, these specimens accounted for 6 of the 14 species presently recorded in the Manaus region (Table 1), representing two families, the Buthidae (5 spp.) and the Chactidae (1 sp.).

Three of the buthids were solely obtained in the trunk/canopy region of the igapó under study: *Tityus adisi* and *T. canopensis* (1 juvenile male each) by fogging the

canopy with pyrethrum at the end of a 6-month long submersion phase (July 1979; cf. ERWIN 1983), and *T. lokiae* (1 female with 10 juveniles) at the beginning of the submersion phase (April 1985) from a bromeliad (see above).

The chactid, *Chactopsis amazonica* (1 juvenile female), occurred in litter of the forest floor during the early emersion (non-flooded) phase (October 1982). This species is considered terricolous in non-flooded upland (terra firme) forests of the Manaus region (LOURENÇO & FRANKE 1986).

The two other buthid species of the igapó, *T. silvestris* (15 adults, 1 juvenile) and *T. metuendus* (5 adults, 6 immatures), were collected from both the non-flooded forest floor and the trunk/canopy region. Both species are common in Amazonian forests (LOURENÇO 1994; LOURENÇO et al. 2000). In non-flooded upland stands around Manaus they mostly occur on and near the forest floor (in litter, under logs and bark), representing the terricolous arthropod guild (cf. ADIS 1997). Juveniles sometimes climb vegetation (LOURENÇO 1997). In blackwater inundation forests of the lower Negro Basin, which both the species seem to have colonized secondarily, they represent the arboricolous guild, inhabiting the trunk/canopy region, in particular epiphytes (e.g., 5-25 m above ground in the bromeliads *Aechmea setigera* and *Streptocalyx poeppigii*). Juveniles largely occur there during the submersion period when prey is abundant, as many terricolous arthropods of the igapó temporarily migrate into the trunk/canopy region where they pass annual inundation (ADIS 1997). *T. metuendus* has also been taken from flooded palm trees in inundation forests near Iquitos, Peru (LOURENÇO & CUELLAR 1999). The shift of habitat from forest floor on terra firme to trunk/canopy in inundation forest, which apparently concerns several *Tityus* species, is considered as an adaptation to the annual flood pulse and has been reported for the pseudoscorpion *Brazilatemnus browni* in Amazonia as well (ADIS et al. 1988).

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Table 1: Check-list of the species known from the Manaus region: \*in blackwater inundation forest at the Tarumã Mirim river.

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Family Buthidae C.L. KOCH, 1837

Genus *Ananteris* THORELL, 1891

*Ananteris dekeyseri* LOURENÇO, 1982

*Ananteris pydanieli* LOURENÇO, 1982

Genus *Tityus* C.L. KOCH, 1836

\**Tityus adisi* LOURENÇO & PÉZIER, 2002

\**Tityus canopensis* LOURENÇO & PÉZIER, 2002

\**Tityus lokiae* n.sp.

\**Tityus metuendus* POCOCK, 1897

*Tityus raquelae* LOURENÇO, 1988

\**Tityus silvestris* POCOCK, 1897

*Tityus strandi* WERNER, 1939

Family Chactidae POCOCK, 1893

Genus *Auyantepuia*\* (1) GONZALEZ-SPONGA, 1978

*Auyantepuia mottai* LOURENÇO & ARAÚJO, 2004

Genus *Broteochactas* POCOCK, 1893

*Broteochactas fei*\*\* (2) PINTO-DA-ROCHA, GASNIER, BRESCOVIT & APOLINARIO, 2002

*Hadrurochactas polisi* (MONOD & LOURENÇO, 2001)

Genus *Brotheas* C.L. KOCH, 1837

*Brotheas amazonicus* LOURENÇO, 1988

Genus *Chactopsis*\*\*\* (3) KRAEPLIN, 1912

\**Chactopsis amazonica* LOURENÇO & FRANCKE, 1986

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\* (1) Note: *Auyantepuia* was revalidated by LOURENÇO & ARAÚJO (2004), but SOLEGLAD & FET (2005) replaced this genus in synonymy. Different authors use distinct characters to define this genus, what leads to disagreements.

\*\* (2) Note: Several *Broteochactas* species were transferred to a new genus, *Neochactas* created by SOLEGLAD & FET (2003). Most of the decisions by these two authors were done only on theoretical basis. For this reason this new classification is refuted by one of the authors (WRL) until further investigations can be done.

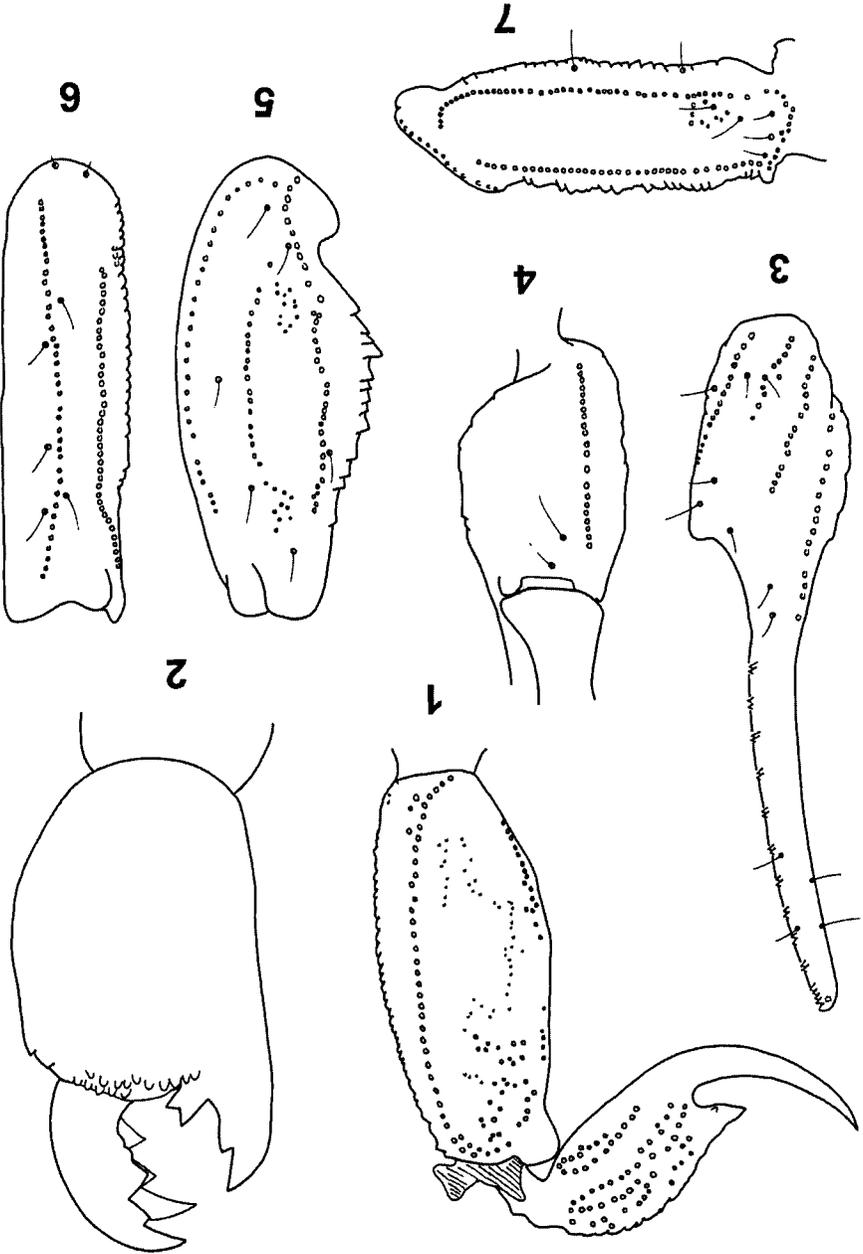
\*\*\* (3) Note: SOLEGLAD & SISSOM (2001) transferred the genus *Chactopsis* to the family Euscorpidae. More recently, LOURENÇO (2003) studied the male genitalia of *Chactopsis amazonica* LOURENÇO & FRANCKE, 1986, and suggested that this decision should be further investigated.

Table 2: Morphometric values (in mm) of the holotypes of *Tityus lokiae* n.sp., *Tityus adisi* and juveniles of instar I *Tityus lokiae* n.sp. and *Tityus silvestris*.

	<i>T. lokiae</i> n.sp.(F)	<i>T. adisi</i>	<i>T. lokiae</i> (J)	<i>T. silvestris</i>
Total length	27.7	9.8	11.5	12.9
Carapace:				
- length	3.2	1.4	1.7	1.7
- anterior width	2.3	1.0	1.2	1.3
- posterior width	3.6	1.4	1.8	2.0
Metasomal segment I:				
- length	2.2	0.8	1.0	0.9
- width	1.8	0.8	0.8	0.8
Metasomal segment V:				
- length	3.8	1.4	1.8	1.8
- width	1.7	0.6	0.7	0.7
- depth	1.6	0.7	0.8	0.8
Vesicle:				
- width	1.2	0.5	0.5	0.5
- depth	1.2	0.4	0.5	0.6
Pedipalp:				
- Femur length	2.6	1.0	1.2	1.5
- Femur width	1.0	0.3	0.5	0.5
- Patella length	3.5	1.4	1.5	2.0
- Patella width	1.5	0.5	0.7	0.7
- Chela length	5.6	2.0	2.6	3.1
- Chela width	1.2	0.2	0.5	0.5
- Chela depth	1.2	0.2	0.4	0.5
Movable finger:				
- length	3.9	1.4	1.9	2.1

*Thyus loktae* n.sp. (holotype). 1: Metasomal segment V and telson, showing the spinoid subscular tubercle. 2: Chelicera. 3-7: Trichobothrial pattern. 3-4: Chela dorso-external and ventral aspects. 5-6: Patella dorsal and external aspects. 7: Femur, dorsal aspect.

Figs. 1-7:



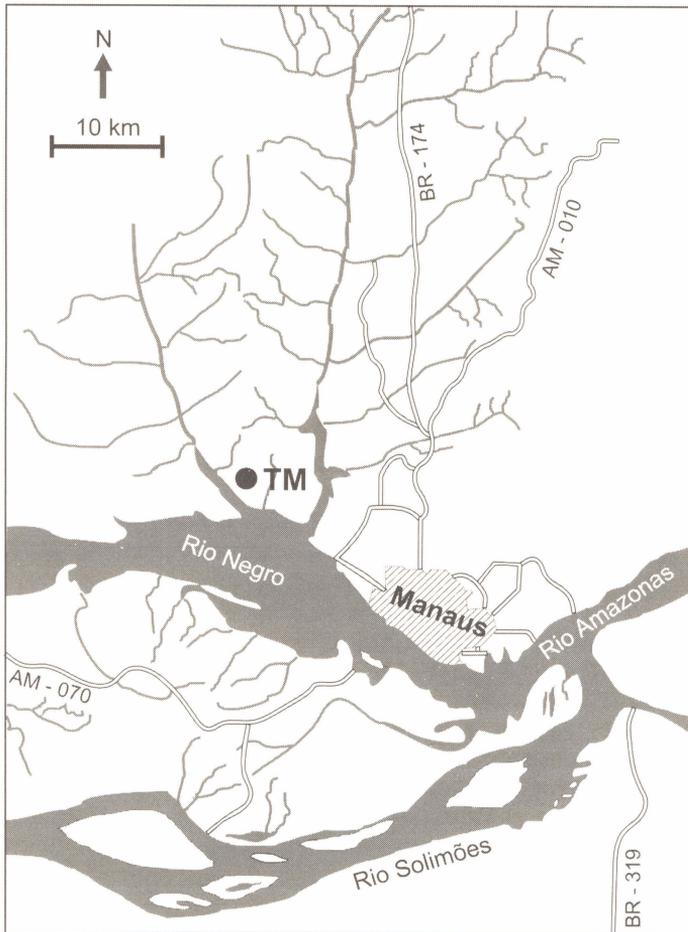


Fig. 8:  
Map of the Manaus region, showing the sampling site at the Tarumã Mirim river (03°02'S, 60°17'W).

